FEDERAL REPUBLIC OF GERMANY

GERMAN PATENT OFFICE

12. **Offenlegungsschrift**

11. **DE 3640035 A1**

51. Int. Cl.[4]:

A 61 B 5/08

21. Application No.: P 36 40 035.1

22. Filing date: 24.11.86

43. Date laid open to public inspection: 26.5.88

71. Applicant:

Erich Jaeger GmbH & Co KG, 8706 Höchberg, DE

72. Inventors:

Dorsch, Albin, 8702 Zell, DE; Eichler, Rüdiger, 8705 Zellingen, DE

74. Representatives:

von Bezold, D., Dr.rer.nat.; Schütz, P., Dipl.-Ing.; Heusler, W., Dipl.-Ing.; Patent Attorneys, 8000 Munich

54. **A device for investigating lung function**

A device is described for investigating lung function, which contains a respiration tube which can be coupled to the respiration passageways of an experimentee and which can be connected via pneumatically controlled valves to different breath bags according to choice. To facilitate sterilisation, the respiration tube, the valves and the respiration gas lines leading to the different breath bags are accommodated in a valve unit which is mounted on a supporting body so that it is easily detachable.

FEDERAL PRESS 04.88 808 821/384

Claims

1 A device for investigating lung function, comprising

- an experimentee pipeline (respiration tube 12) for connection to the respiration passages of an experimentee,
- a plurality of respiration gas pipelines (28, 28b...) which each comprise a connection for a gas container such as a breath bag (30a, 30b ...),
- a plurality of pneumatically controlled valves (26a, 26b ...) for connecting the experimentee pipeline to one of the respiration gas pipelines according to choice,
- gas removal pipelines (46a, 46b ...) for taking gas samples from the gas containers and/or from at least one of the experimentee and respiration gas pipelines (12, 28a, 28b ...),
- a valve controller (34a, 34b ..., 44) for generating pneumatic control signals for the valves (26a, 26b ...), and
- control signal pipelines (32a, 32b ...) for feeding the control signals from the valve controller to the valves, **characterised in that**
- the experimentee pipelines (12), the respiration gas pipelines (28a, 28b...) with the connections for the gas containers (30a, ...), and the valves (26a, 26b...) are disposed in a valve unit body (54) which is mounted on a supporting body (52) by means of an easily detachable attachment device which comprises a valve unit coupling face (56) which adjoins a supporting body coupling face (58) on the supporting body (52),
- the gas removal pipelines (46a, 46b ...) and the control signal pipelines (32a, 32b ...) comprise a first part which extends in the supporting body (52) and which ends at a mouth in the supporting body coupling face (58), as well as a second part which extends in the valve unit body (54) and ends at a mouth in the valve body coupling face, and
- the mouths of the two parts of each pipeline are imperviously connected to each other when the valve unit body (54) is mounted on the supporting body (52).

2. A device according to claim 1, characterised in that the mouth of the first part of each pipeline is provided with a flexible ring seal (60).

3. A device according to claim 1 or 2, characterised in that the supporting body (52) is plate-shaped and bears solenoid valves (34a, 34b ...), which each connect one of the first-mentioned valves (26a, 26b ...) to a pressure medium line (36).

4. A device according to claim 3, characterised in that the pressure medium line (36) is connected to a buffer vessel (40) disposed on the supporting body (52).

5. A device according to any one of the preceding claims, characterised in that the supporting body (52) contains two plate-shaped parts which are joined to each other at two opposite faces, and that the first parts of the pipelines contain channel-like recesses in one of these two faces.

6. A device according to any one of the preceding claims, characterised by a box which is removably attached to the supporting body, and which surrounds the gas containers (30a, ...) and the interior of which is connected to the atmosphere via a further pipeline and a flow measuring device.

7. A device according to claim 6, characterised in that the further pipeline runs through the valve unit body into the supporting body.

Description

The present invention relates to a device for investigating lung function as is presupposed in the characterising clause of claim 1 to be known in view of DE-OS 30 29 155.

The known device has an experimentee pipeline (respiration tube) for connection to the respiration passageways of an experimentee by means of a mouthpiece or a mask, and also has a plurality of respiration gas pipelines which each comprise a connection for a gas container such as a breath bag, and which can be connected, according to choice, via a pneumatically controlled valve and a distributor, to the experimentee pipeline. These valves are controlled by a valve controller depending on the respiration phase of the experimentee and according to a predetermined program which depends on the investigation to be performed each time. The valve controller provides pneumatic control signals, e.g. compressed air signals, for the valves, and for this purpose is connected via control signal pipelines to the control inputs of the pneumatically controlled valves. In addition, gas removal pipelines which lead to gas analysis instruments are provided for taking gas samples from the respiration tube and from the breath bags. The breath bags can be accommodated in a closed, airtight box, the interior of which is connected to the ambient air via a flow sensor (pneumotachograph tube) in order to generate an electrical signal which depends on the respiration flow (flow). A flow signal can also be generated by means of a resistance to flow which is disposed in the respiration tube, and a differential pressure measuring device.

In devices of the type described above, the parts through which the respiration air flows, including the respiration tube, the valves, and the respiration gas pipelines which lead to the breath bags, must be sterilisable. With this known device, however, sterilisation is associated with the expenditure of considerable effort due to the requisite cumbersome dismantling of the corresponding parts and due to the necessity of separating the various gas removal pipelines and the like.

The underlying object of the present invention is accordingly to further develop a device according to the precharacterising clause of claim 1 so that dismantling and sterilisation can be performed rapidly and simply.

For the device cited at the outset, this object is achieved according to the invention by the characterising features of claim 1.

The subsidiary claims relate to other designs and advantageous embodiments of the device according to the invention.

In the present device, the experimentee pipeline (respiration tube), the pneumatically controlled valves, the respiration gas pipelines and part of the pipelines for gas removal and for transmitting the pneumatic valve control signals are assembled to form a valve unit, the body of which is mounted on a supporting body so that it is easily detachable. Coupling faces on the valve unit body and on the supporting body, through which coupling faces the pipelines for gas removal and for the pneumatic valve control signals run, adjoin each other.

An example of an embodiment of the invention is explained in more detail below with reference to the drawings, where:

Figure 1 is a schematic illustration of part a device according to one embodiment of the invention;

Figure 2 is a schematic sectional view of part of the device shown in Figure 1;

Figure 3 is a schematic illustration of a valve unit body and a supporting plate of the device shown in Figure 2, in their disassembled state ; and

Figure 4 is a schematic illustration of an embodiment of a connecting apparatus for the device shown in Figures 1 to 3.

The device which is illustrated as an example of an embodiment of the invention for investigating lung function contains an experimentee pipeline (12) which is often described as a "respiration tube", to which an experimentee to be investigated can be connected by a respiration mask or a mouthpiece (14). In general, the respiration tube contains a flow measuring device, which can contain a resistance to flow (16) and a differential pressure measuring device (18) which is connected via two pressure signal pipelines (18, 20) to locations on the respiration tube situated on both sides of the resistance to flow (16). Alternatively, the flow measuring device can contain a Venturi nozzle (22) as illustrated in Figure 2. The pressure signal pipelines (18, 20) then lead into the narrowest point of the Venturi nozzle or into locations of the respiration tube (12) remote from the mouthpiece connection (24).

The experimentee pipeline is then connected via a plurality of pneumatically controlled valves, each with a connection (28a, 28b, 28c ...) for a gas container such as a breath bag (30a, 30b, 30c ...), which can consist, as usual, of a thin, flexible plastics film or of rubber. The valves each have a control input which is connected via a control signal pipeline (32a, 32b, 32c ...) and a solenoid valve (34a, 34b ...) to a line (36) to which a buffer vessel (40) is connected and to which a source of compressed air, which is not illustrated, is attached via a connection (38). The solenoid valves are controlled by a controller (44), which can be a microcomputer, via electrical control lines (42a, 42b ...) illustrated as dash-dot lines. Gas removal pipelines (46a, 46b, 46c ...),which lead to gas analysis instruments (48a, 48b ...), lead into the breath bags. If desired, the gas analysis instruments can be connected alternately to one of the gas removal pipelines via corresponding distributors or valves.

The electrical output signals from the differential pressure measuring device (18) and from the gas analysis instruments (48) can also be fed to the controller (44) for processing and/or for triggering control operations.

The breath bags (30a) can be disposed in an airtight box, which is not illustrated in Figure 1 but the interior of which is connected to the surroundings via a flow measuring device.

As described thus far, the device is known in principle from DE-OS 30 29 155.

To facilitate sterilisation of the parts which come into contact with the respiration air of the experimentee, the respiration tube (12), the valves (26), the connections (28) and part of the pipelines (18, 20, 32 and 46) which adjoin these elements can be assembled to form a valve unit (50) which is fixed to a supporting body (52) so that it is easily detachable. The valve unit (50) has a body (54) (Figure 2) comprising a coupling face (56) which adjoins a coupling face (58) of the supporting body (52). The pipelines (18, 20, 32, 46) each have a part which extends in the valve unit body (54) and which leads into the coupling face (56), as well as a part which extends in the supporting body (52) and which leads into the coupling face (58). The corresponding mouths of the lines are sealed from each other, e.g. as shown in Figure 2 by an O-ring (60) which is advantageously seated in a corresponding recess in the supporting body (52). In Figure 1, the sealed coupling or connection points of the gas lines are denoted by "x".

The supporting body (52) preferably consists of two plates, e.g. made of acrylic resin, which rest on each other, wherein the parts of the pipelines which come from the valve unit (50) pass perpendicularly through one plate and continue in the form of countersunk formations in the adjacent surface of the other plate without crossovers (as in printed electrical circuits). The second plate, which is the upper plate as shown in Figure 2, bears the solenoid valves (34a, 34b) and the buffer vessel (40). The various lines can terminate in pipe nozzles (62) which are connected via flexible tubular lines to the source of compressed air, the gas analysers, etc., which can be situated at another location in the device.

As shown in Figure 2, the valve unit (50) is fitted to the supporting plate (52) from below. To ensure a secure, positionally accurate and easily detachable connection of the valve unit (50) to the supporting plate (52), connecting devices can be used as illustrated in Figure 4. The connecting device illustrated contains a pin (64) which protrudes upwards from the coupling face (56) of the valve unit body (50) and which has a thicker, spherical head which is pushed through a hole (66) in the supporting plate when the valve unit body (50) is fitted to the supporting plate (52). Accurate coverage of the mouths of the various gas lines is ensured by coding pins (68) which protrude from the coupling face of the supporting plate (52) and fit into corresponding coding holes (70) in the coupling face (56). On the upper side of the

supporting plate (52) there is a wedge-shaped component (72) which has a slot (73) which is enlarged at the thinner end of the wedge-shaped component (72) so that the spherical head of the pin (64) can pass through. The component (72) is displaceably mounted in a T-shaped slot (74) in the supporting body (52) and is coupled to an operating device (76) which contains a handle (78), which, via a crank-like component (79) comprising a pin (80), fits into a slot (82) which extends substantially perpendicularly to the surface of the supporting plate (52). When the pin (64) is pushed through the hole (66) and the handle (78) is swivelled into the position (78a) shown by the dashed lines, the wedge-shaped component (72) is pushed outwards, and the head of the pin (64), which cannot pass through the narrower part of the slot (73), is pulled upwards due to the wedge effect, so that the coupling faces (56, 58) are pressed against each other and a secure, impervious connection is made to the various gas lines. When the handle (70) is swivelled upwards, the pin (64) is released, so that the valve unit body (50) can be removed downwards and can be sterilised, e.g. by gas or steam. In practice, two or more connecting devices of the type illustrated in Figure 4 can be provided.

The flow measuring device, which contains a Venturi nozzle, a resistance to flow and the like, does not need to be situated in the valve unit body, but can also be contained in a separate pneumotachograph unit or the like which can be attached to the connection (24). As indicated by the dashed lines in Figure 2, a rigid box (84) which is easily detachable can be mounted on the underside of the plate-shaped valve unit body. This box surrounds the breath bag and forms what is termed a bag-in-box system therewith. The interior of the box is connected to a flow measuring device via a flow channel, which preferably extends through the valve unit body into the supporting body and which at the transition from one body to the next can be sealed in the manner described above, e.g. for line (18). The term "pipeline" which is used in order to make a distinction from electrical lines can comprise gas channels of any type, and is not limited to tubular products.

(Drawing sheets)

Number: **36 40 035**
Int. Cl.[4]: A 61 B 5/**08**
Filing date: 24 November 1986
Date laid open to public inspection: 26 May 1988

On Figures 2 to 4:

SUBMITTED SUBSEQUENTLY